NASA STTR 2004 Phase I Solicitation

T4.01 Earth Science Sensors and Instruments

Lead Center: GSFC

The mission of the Earth Science Enterprise is to develop a scientific understanding of the Earth system and its responses to natural and human-induced changes to enable improved prediction of climate, weather, and natural hazards for present and future generations. By using breakthrough technologies from terrestrial applications, as well as the vantage point of space, we seek to observe, analyze, and model the Earth system to discover how it is changing and the consequences for life on Earth.

This STTR solicitation is to help provide advanced remote sensing technologies to enable future Earth and Lunar Science measurements.

Analytical Instrumentation for Planetary Atmospheres Research

Innovations and the application of new technologies are sought for improving the operating characteristics of gas chromatograph-mass spectrometer systems in harsh environments. Reductions in volume, weight, power, and cost while increases in performance, serviceability, and functionality of system components is highly desirable. The overall goal is to develop an instrument with increased performance in the areas of improved collection, detection, and measurement. Specific areas of interest include:

- Miniaturized and ruggedized gas chromatograph columns
- Microvalves
- Improved stability and performance of secondary electron multipliers
- Performance increases in the areas of size and conversion efficiency of high voltage DC/DC converters
- Rigid miniature vacuum pumps

Microwave Measurements Using Large Aperture Systems

New breakthrough technologies are sought for the construction of extremely large (tens of meters and larger diameter) microwave antenna systems. The systems must be compact upon launch, they must achieve high precision surface form factors, and they must include beam-scanning capabilities. The antenna compactness on

launch can be achieved either through folding technologies or from some assemblage of small components into the larger final system in space. The microwave antenna surface characteristics must be accurate enough to produce microwave beam patterns with adequately small side lobes. The beam scanning must be facile and over many beam widths so as to enable cross-track scanning if in LEO, or scanning over the full globe if at GEO. The beam widths must be small enough to resolve the few kilometer scales needed for many geophysical observations. The microwave wavelengths will be determined according to the geophysical measurement of interest. The antenna concepts may include large single apertures or apertures composed of multiple elements that are operated synergistically to produce the desired performance.

Active Optical Systems and Technology for UAVs and Balloonicraft

Lidar remote sensing systems are required to meet the demanding requirements for future Earth Science missions. It is envisioned that lidar systems will be used in the following application areas: high spatial and temporal resolution observations of the land surface and vegetation cover (biomass); profiling of clouds, aerosols, and atmospheric state variables including temperature, humidity, winds, and trace constituents including tropospheric and stratospheric ozone and CO_2 (profiling and total column); measurement of the air/sea interface and mixed layer. New systems and approaches are sought in these areas, which will:

- Enable a new measurement capability;
- Enhance an existing measurement capability by significantly improving the performance (spatial/temporal resolution, accuracy, range of regard); and
- Substantially reduce the resources (cost, mass, volume, or power) required to attain the same measurement capability.

Systems and approaches will be considered that demonstrate a capability which is scalable to space or can be mounted on a relevant platform (UAV, long duration balloon, or aircraft) for calibration and validation of a space-borne system.

Unmanned Aerial Vehicle (UAV) Technologies for Remote Sensing

Avionics, real-time telemetry acquisition and remote sensing spectral imaging devices to support Unmanned Aerial Vehicles' (UAV) basic and applied science and application demonstrations (proposers need only to respond to a minimum of one of the below):

- Low cost avionics instrumentation for precise navigation and aircraft control, must have an attitude sampling rate greater than 25 Hz and an accuracy greater than 0.2° in roll and pitch.
- Real-time sensor fusion algorithms that combine low-cost inertial, GPS, magnetometer, and other sensor input to deliver aircraft state vectors at a rate greater than 50 Hz.
- Uncooled infrared and thermal spectral imager instrument to be less than 2 lbs and no larger than 0.05 m^3 in volume. Must operate autonomously in coordination with the onboard flight plan. It must have a built-in data acquisition system. The spectral bands must all be coregistered and the data must be GPS time tagged. Spectral bands should be centered at 3.75, 3.96, and 11microns as well as a band in the visible at 0.6 microns. Quantization bit resolution should be 10-bit minimum.

Balloonicraft Trajectory Control and Station-Keeping

Trajectory Control and Station-Keeping are critical items for future Ultra-Long Duration Balloon remote sensing concepts.

- Trajectory control would allow for some authority of the path of the system that may be required or desired for several reasons such as science mission, geopolitical, or improved recovery options. Activities include concept studies for alternative systems, propeller design and fabrication, functional flight testing, airship design and analysis, material development, and performance modeling.